

## OBSERVATIONS ON SOME AUSTRALIAN FOREST INSECTS.

4. *Xyleborus truncatus* ERICHSON 1842 (COLEOPTERA: SCOLYTIDAE) ASSOCIATED WITH DYING *EUCALYPTUS SALIGNA* SMITH (SYDNEY BLUE-GUM).

By K. M. MOORE, Forestry Commission of New South Wales.

(Plate vii; three Text-figures.)

[Read 27th May, 1959.]

---

Summary.

Numerous deaths of trees of *E. saligna* Smith on State Forests and private property, with consequent economic loss, have recently caused concern to Forestry officers and landholders.

Investigations into the causes of these deaths and the association of attack by *Xyleborus truncatus* Erichson with brown staining in the wood of dying trees are described.

Biology, hosts and distribution of the insect are given and typical damage is described and figured.

Results of assessments of the quantity of commercial timber destroyed in two areas of greatest tree-mortality are included; the areas are mapped and their locations are given.

The factors apparently contributing to attack by *X. truncatus* and deaths of trees are discussed.

---

INTRODUCTION.

*Eucalyptus saligna* Smith (Sydney blue-gum) occurring on State Forests and private property in coastal areas of New South Wales was reported as dying during the period 1949 to 1958, the increasing number of deaths reaching economic significance toward the end of that period. Throughout that time, psyllids of the genus *Spondyliaspis* (Hemiptera: Psyllidae) were occurring in plagues and causing severe defoliation and debilitation of several *Eucalyptus* species.

Attention was first drawn to this problem on private property in the Gosford-Wyong area by Mr. P. C. Hely, at that time District Entomologist, Department of Agriculture, Gosford, who reported that many local residents were blaming *Manorina melanophrys* Latham (bell-birds) for the general debilitation of blue-gums in the area. Hely suggested that psyllids of the genus *Spondyliaspis* were more likely to be the cause (unpublished report, 1950). An investigation of the food of the bell-birds was made by Campbell and Moore (1956).

During the years 1953 to 1956 single, scattered, dying trees were observed in many areas, and the deaths of *E. saligna* on State Forests and private property were beginning to cause concern to Forestry officers and owners of private property. By this time the psyllids had attained plague proportions on trees in numerous gullies, on slopes, and on the flats, and had caused partial or complete defoliation continually for some years.

The initial association of *Xyleborus truncatus* Er. (Pl. vii, 1b, 1c) with a dark brown staining in the timber of a dying tree was observed during May 1954 at Lisarow, N.S.W. The foliage of an *Angophora intermedia* De Candolle (rough-barked apple) about twenty feet in height, was observed to be brown and apparently dead, and a colony of the beetle was present in the trunk of the tree at approximately six feet above ground level. Dark brown staining of the wood above and below this colony was extensive, and no other evidence of the possible cause of death was observed. *A. intermedia* is not known to be a host of *Spondyliaspis* spp.

## SELECTION OF STUDY AREAS.

Investigations to determine the causes of tree mortalities were begun by the writer during November 1956 at Ourimbah State Forest No. 290, where an area of forest

approximately two miles in length and five to ten chains in width, extending along the centre of a north-easterly slope, was severely infested with *Spondylia* spp., and on property of Mr. J. Catt of Lisarow. A study of the biology and ecology of the psyllids which was made in those areas will form the subject of a separate paper.

When a wood-boring beetle was invariably found in association with the debilitated trees, many other areas of forest were also examined where the psyllids were present in large numbers and deaths of *E. saligna* were occurring.

When selecting areas for intensive examination, those where logging had occurred during the previous ten years were regarded as unsatisfactory for the purpose, because the healthier, larger and better quality trees suitable for economic utilization had been removed. Those remaining were generally deformed or affected by insect attack (mainly by Lepidoptera, Coleoptera or Isoptera), decomposition of the wood where mechanical injury had occurred, or fungi.

The numerous effects of fire in a stand of timber are not completely understood, and because these may have introduced unknown variables during investigations, areas where fire had occurred within the previous ten years were also considered unsuitable.

A gully was selected at Lisarow on the opposite side of the creek to the area assessed and shown in Text-figure 1, where a stand of large and previously vigorous *E. saligna* trees occurred and where there had been no logging or fire after 1945. The gully extended approximately north and south, with a northerly aspect, the timber-stand composition on its slopes being principally of *E. pilularis* J. E. Smith (blackbutt), *E. paniculata* J. E. Smith (grey iron-bark), *Syncarpia laurifolia* Tenore (turpentine), *A. intermedia*, *E. saligna* and *E. acmenioides* Schauer (white mahogany), with the two latter species predominating. From the central area of the slopes and extending to the creek, palms, brush-woods and vines formed a moderate to dense cover beneath these species. This area had been severely attacked by *Spondylia* sp. for at least eight years prior to these investigations.

#### METHODS OF STUDY.

Twelve trees of *E. saligna* which appeared almost dead were selected for observations on the association of their probable deaths with some cause other than the psyllid attack. The twelve trees examined varied in height from thirty to ninety feet, and in diameter at breast-height-over-bark from seven to fifteen inches. The trunks were apparently free from injury or insect attack, and the trees had previously made vigorous, straight growth. Each tree was felled and cut into various lengths, which were then examined for evidence of any agent which may have contributed to the tree's debility. Attack by *Spondylia* sp. and *X. truncatus* was found to occur on each tree.

There does not appear to be a precise definition of a "dying", "almost dead" or "dead" tree, and it was necessary to establish a practical classification of tree condition for the purpose of this study. This was formulated by the writer after two years of observations on most of the Gosford-Wyong area, which included approximately 150 separate areas where the psyllids occurred in large populations and trees of *E. saligna* were in various stages of debilitation. From this survey it was assumed that the majority of trees bearing dead branches, and with relatively few epicormics, would die, and this was considered to be a practical basis for these investigations.

#### RESULTS OF INVESTIGATIONS AND DESCRIPTION OF DAMAGE.

In all areas examined where *X. truncatus* occurred and damage by the psyllids was severe, trees were found to be in various stages of debility. Some showing vigorous regrowth of crowns appeared healthy; others carried one or more dead branches with variable amounts of foliage or some epicormics on the trunk or branches, while other trees had died.

Many trees severely affected by the psyllids were attacked by *X. truncatus*, and in these, variable degrees of dark brown staining of the timber occurred contiguous to the hole made by the beetle. This staining extended in a strip of variable width, from the

entrance hole and along the sapwood for varying distances toward both the bases and the crowns of the trees. In a number of instances it was found to have penetrated the truewood.

Early stages of attack were denoted by a dark brown stain approximately one-quarter of an inch in width on the surface of the sapwood, extending above and below the hole for from two to six inches. In the later stages, this stain had spread along the sapwood and truewood, principally below the holes, becoming paler brown in colour as it extended down the trunk, and the bark covering the stained area had eventually cracked and died.

In trees assumed to be almost dead, the stain covered by the dead and dying bark sometimes reached to ground-level. The earlier stages showed little or no cracked bark. The cracking of the bark always began contiguous to and beneath the scolytid hole, spreading downwards.

In some of the less debilitated trees attack by *X. truncatus* was not always found. Attack in a tree was usually indicated by the presence of one or more dead lower branches, with little or no crown foliage, or with epicormics on the trunk or branches.

During the preliminary investigation of severely debilitated trees, extensive brown staining of the wood tissues was associated with scolytid attack in four areas of forest which were in some instances as far as twelve miles apart. Live or dead beetles of *X. truncatus*, or its colony chambers, were found in fourteen of the sixteen trees inspected throughout these areas. In the other two trees staining was associated with borer holes (probably those of this scolytid), but these did not contain beetles or larvae.

The association of *X. truncatus* attack with brown staining and the probable death of a tree was consistently established in almost every tree out of a total of approximately 60 examined thereafter.

The founding of a colony of *X. truncatus* is not necessary for staining of the timber to become evident, or for the death of a tree; a single hole, sometimes containing a dead beetle only, was at times sufficient to produce the condition. Initial attack on a tree by *X. truncatus* was usually found in the dead or dying lower branches of the tree-crown, and occurred either high or low in the trunk only when a tree was apparently considerably debilitated.

Trees on which the crown or epicormic growth appeared vigorous and healthy as though recovering from psyllid attack, and those considered nearest to death, showed attack by *X. truncatus*. Some trees were apparently able to withstand a single attack, although others showing a single attack had died.

Attack by *X. truncatus* with consequent death of trees sometimes occurs where the psyllids have played no part in their debilitation, although prolonged attack by *Spondyliaspis* sp., or damage by other agencies, apparently reduces the vitality of trees, causing them to become susceptible to attack by *X. truncatus*.

#### OTHER SPECIES OF WOOD-BORING COLEOPTERA.

Additional wood-boring beetles observed attacking debilitated *E. saligna* are as follows:

ANOBIIDAE: *Derophtinus granicollis* Lea.

BOSTRYCHIDAE: *Xylion cylindricus* Macl., *X. collaris* Er., *Xylopsocus gibbicollis* Macl.

BRENTHIDAE: *Cyphagogus bipunctatus* Senna.

PLATYPODIDAE: *Platypus australis* Froggatt.

SCOLYTIDAE: *Xyleborus compressus* Lea, *X. pseudoangustatus* Schedl, *X. solidus* Eichh.

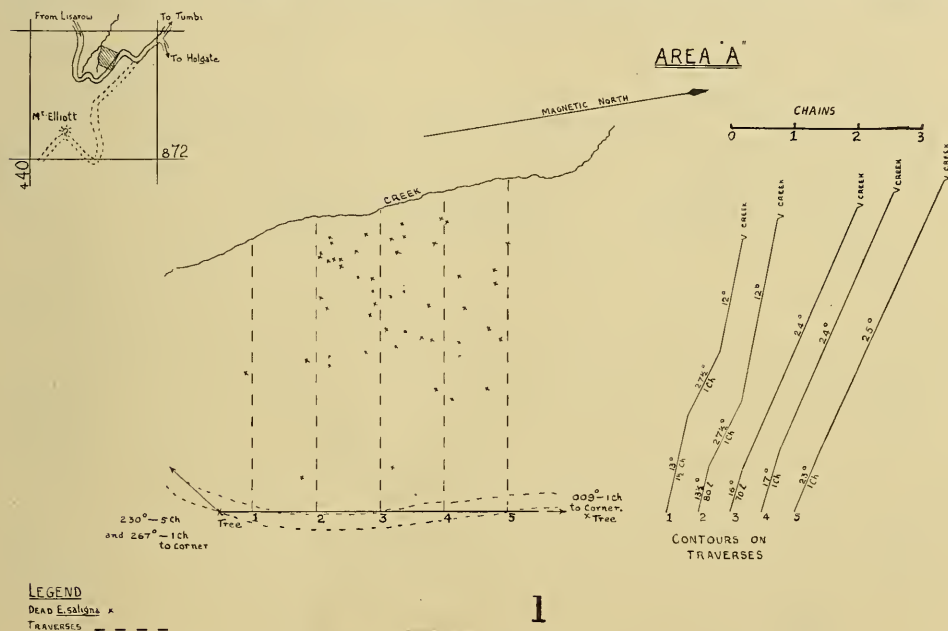
In the trees examined, attack by *X. truncatus* always preceded any evidence of attack by these other species.

## LOSS OF COMMERCIAL TIMBER.

To determine the amount of commercial quality timber represented by the *E. saligna* killed on two areas of forest, one hundred percent. assessments were made of 2.4 acres on the property of Mr. J. Catt at Lisarow (area "A", Text-fig. 1), and 1.05 acres on Ourimbah State Forest (area "B", Text-fig. 2). The locations of these areas on the Gosford-Norahville military sheet, Zone 8, are shown as insets on the respective figures.

From the surveyed baselines of each of the assessed areas traverses at 90° and at one chain intervals were made. Trees within one half-chain on either side of these traverses were assessed, and marked to obviate duplication of assessment.

On area "A" 92 trees were measured and assessed for the quantity of commercial timber which they represented. Fifty-one trees (55%) were classified as dead (of this number 19.6% were assessed as "expected to die" because of the extent of their debility



Text-fig. 1.—Area "A" of assessed *E. saligna*, on property of Mr. J. Catt, Lisarow, N.S.W. Location 440,600 east, 872,750 north.

when examined). The amount of commercial timber represented by the fifty-one trees was 9,409 super feet hoppus (58% of the total s.f. hoppus of *E. saligna* on the area), and that by the trees classified as "living", 6,813 s.f. hoppus.

On area "B" 69 trees were assessed. Forty-one trees (59%) were classified as dead (this figure included 24% assessed as "expected to die"). The timber represented by the forty-one trees totalled 16,156 s.f. hoppus (64.9% of the total s.f. hoppus of *E. saligna* on the area), and that by the trees classified as "living", 8,724 s.f. hoppus.

Totals for both of the assessments:

Dead trees:	92 (57%)	25,565 s.f. hoppus.
Living trees:	69 (43%)	15,537 s.f. hoppus.
Grand total:	161 trees	41,102 s.f. hoppus.

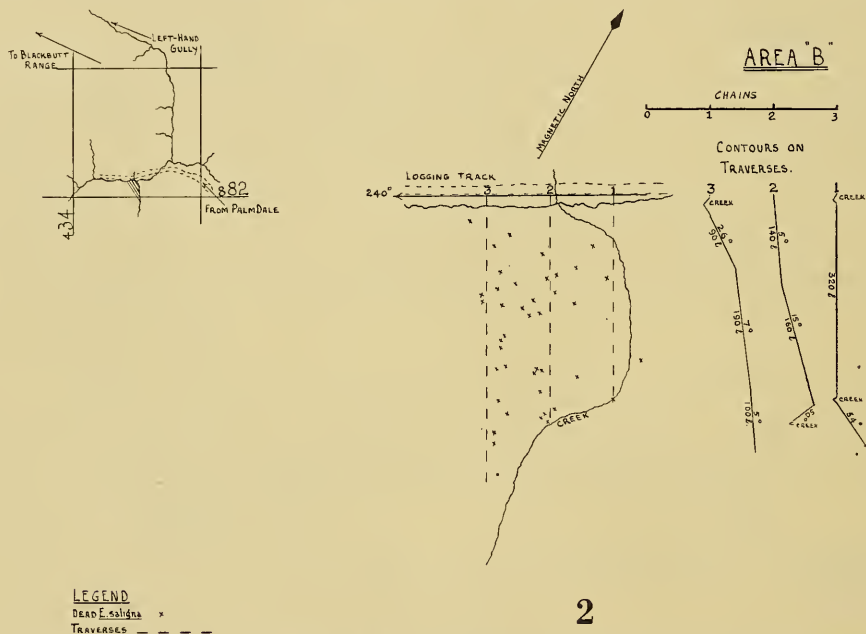
Volumes of timber derived from these assessments are based on Forestry Commission Recovery Tables for *Eucalyptus grandis* (flooded gum), Pine Creek S.F. (a closely allied species), which were considered adequate, as tables for *E. saligna* were not available. These figures are indicative of the loss of commercial timber in areas where the incidence of mortalities was greatest.

## DISTRIBUTION.

*X. truncatus* is widely distributed. The original description by Erichson (1842) is based on a specimen from Van Diemen's Land. A specimen from Armidale, N.S.W., was described by Lea (1893), who also gave South Australia and Tasmania as localities. Specimens were collected at Forbes and Ourimbah in New South Wales, and also in Victoria by Froggatt (1926). Brimblecombe (1953) records its occurrence in Queensland. It has been collected at Wentworth Falls, Kincumber and Wyong, N.S.W., by the writer.

## HOSTS.

Froggatt (1926) recorded *E. saligna* and *E. camaldulensis* Dehn. (river red-gum) as hosts. *E. acmenioides*, *E. maculata* Hook. (spotted gum) and *E. citriodora* Hook. (lemon-scented gum) have been recorded by Brimblecombe (1953). *A. intermedia*, *E.*



Text-fig. 2.—Area "B" of assessed *E. saligna* on Ourimbah State Forest No. 290, Forestry District of Newcastle, sub-district of Wyong. Location 434,500 east, 882,075 north.

*propinqua* Deane & Maid. (grey-gum) and *E. piperita* Smith (peppermint) are recorded by the writer.

From the distribution of *X. truncatus* it is assumed that a wide range of *Eucalyptus* spp. would be attacked.

## BIOLOGY.

Biology of this species is recorded by Froggatt and Brimblecombe.

Approximately sixty trees of *E. saligna* in the eight to twenty-five years age-group were felled in the Gosford-Wyong area during 1957 and 1958 and the following observations made.

*X. truncatus* has been found only in standing trees. The colony-chambers (Pl. vii, 1a) are found in the truewood as deep as two inches within the branches or the trunk, the narrowest portion of the chamber being above the entrance tunnel. The colony-chambers, which vary in size, are approximately 2 mm. wide, 5 mm. in height, with a basal length of 4 mm., their size probably depending on the number of larvae reared in them. The walls of the chambers or the holes are sometimes stained a brown to black

colour which spreads into the sapwood or truewood above and below them. The staining may be seen above and below the galleries in the figure. There may be no typical chamber such as that figured, but only a more or less horizontal hole from the outside of the trunk or limb, and which may contain adults, pupae or larvae.

One colony contained 13 larvae, most of which were in the last instar, and only the base of the colony-chamber was stained. Some live colonies were found in apparently dead and dry branches, although it was more usual to find them in timber which still contained sap.

Froggatt and Brimblecombe refer to attack occurring in damaged areas on trees, where sapwood had been exposed. In each of the instances observed during these investigations, attack occurred through the previously undamaged, smooth bark of *E. saligna* and *E. propinqua* or the rough bark of *A. intermedia*.

The association of *X. truncatus* with dying trees has not previously been reported, although Froggatt recorded that the exposed area of wood surrounding the point of attack turned brown and died.

Oviposition apparently occurs over many months in the one colony, for larvae of most instars, pupae and adults occur together during most months of the year. During these investigations oviposition occurred from October to May, and during the latter month a cluster of approximately 15 eggs was found in a colony-chamber containing larvae and pupae. This suggests that the one colony-chamber may be utilized for the rearing of more than one generation of beetles.

Beetles may bore into either a limb or tree-trunk and die without founding a colony or without evident staining of the timber. Some apparently killed by sap-flow or gum-flow were found in the entrance holes.

The parent beetle appears to attend a colony for some months, and some have been found in entrance holes around the external edge of which a white, powdery substance (probably the excreta of the larvae, or excess fungal growth) had been removed from the gallery. A single exit hole is constructed from the end of the colony-chamber opposite to the entrance hole made by the parent when founding the colony.

The life cycle occupies approximately three months in the warmer weather, and six months or more for the overwintering generation. Emergences of adults from a colony may occur from September to about May, while pale coloured adults, together with last instar larvae, were taken during July. It is presumed that adults would not have emerged from the tree until the following spring.

No parasites of *X. truncatus* were found during these investigations.

Adult bees of *Hylaeus aralis* Ckll. (Colletidae: Hylaeinae) were reared from gallery-chambers. Their larvae overwinter in thin skin-like cells in the galleries.

#### DESCRIPTIONS.

The adults, 2.5 mm. to 3 mm. in length, may be identified by the truncate elytra, a feature which is apparently confined to this one species of the Australian Scolytidae. They superficially resemble species of the Bostrychidae, in which family this feature is comparatively common, and Lea (1893) initially placed *X. truncatus* in that family.

The taxonomy of *X. truncatus* has been referred to by Brimblecombe (1953).

*Larva*.—There is apparently no previous description of a last instar larva of *X. truncatus*, although Froggatt figured a larva without designating to it any particular instar. Last instar (Text-fig. 3): Length approximately 3.5 mm. to 3.8 mm. Head-capsule pale cream with mouthparts varying from tan-colour to dark brown; remainder of larva opaque white; cylindrical; the exoskeleton more or less covered with micro-setae which are visible at high magnifications; apodous; arcuate, with the abdomen prominently deflexed from about the fourth abdominal segment, so that the distal segments are often at an angle of about 90° to the proximal segments; pseudopods present on each thoracic segment; tenth abdominal segment small, and consisting of little more than the anal aperture; the dorsal aspect of each segment except abdominal

segments nine and ten is divided transversely to form an anterior and a posterior protuberance approximately equal in length.

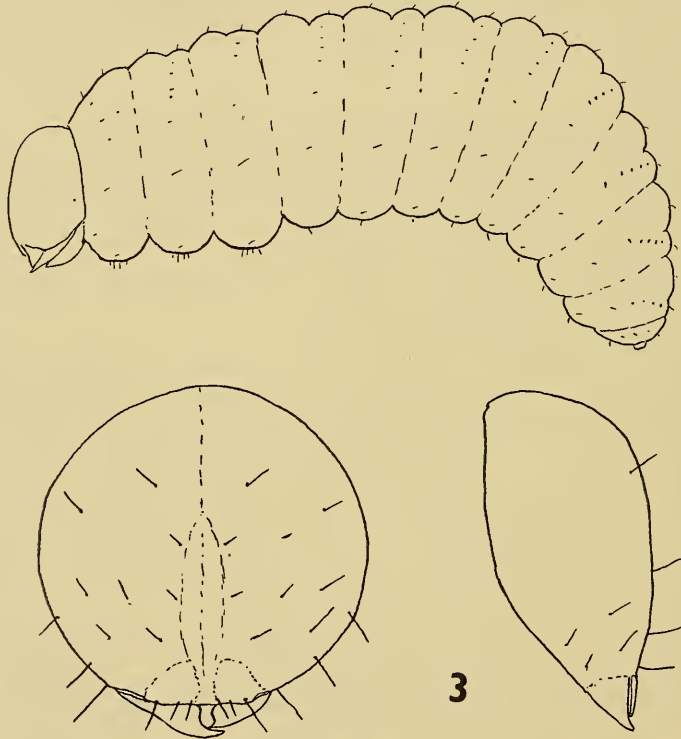
Setal arrangement on the head-capsule and body-segments is shown in Text-figure 3.

*Pupa*.—The pupa, about 3 mm. in length, is at first white, later becoming yellow, then pale brown prior to the emergence of the adult.

#### DISCUSSION.

The cause of deaths of *E. saligna* was not determined, and these observations present a basis for further investigations.

Species of the Scolytidae are known to be vectors of Dutch elm disease, with consequent deaths of trees, in forests of Europe and America (Collins *et al.*, 1936;



Text-fig. 3.—Setal arrangement on body-segments and head-capsule of last instar larva of *X. truncatus*.

Parker *et al.*, 1941), and it is suggested that *X. truncatus* is similarly associated with some pathogen or toxic agent capable of causing tree mortalities. It is most unlikely that the limited damage caused by these beetles would be the direct cause of death.

Certain weather conditions or physiological conditions of trees may be essential for optimum effect of the mortality factor which is not necessarily associated with psyllid or scolytid attack.

The considerable number of dead and dying trees occurring in areas of large psyllid populations and where *X. truncatus* attack occurred was generally associated with debilitation of trees apparently due to, or accentuated by, persistent psyllid attack. However, the *A. intermedia* attacked by *X. truncatus* was not debilitated by psyllids, which suggests that site-favourability may be a factor contributing to debilitation, and thus inducing attack by *X. truncatus*. This may be the principal factor operating in all instances.

From an examination of meteorological records supplied by the Narara Citrus Experiment Station, it is evident that the reports of large populations of psyllids together with debilitation of *E. saligna* correspond with the years of abnormal rainfall experienced from 1949 to 1956. The average annual rainfall for that period was 69.29 inches. Rainfall exceeded 86 inches for each of two years and exceeded 72 inches each year for a further three years during those eight years.

For comparison, the average annual rainfall for the years 1935 to 1941 was 37.16 inches for the seven-year period, while the average annual rainfall for the intervening seven years of 1942 to 1948 (45.06 inches) approached the normal figures for precipitation on the area, which for the 41 years from 1917 to 1957 averaged 49.83 inches per annum.

At present an analysis of factors contributing to deaths of the trees is hypothetical, but the hypothesis considered most tenable is that the abnormal rainfall adversely affected the physiology of *Eucalyptus* and other species generally, making them susceptible to heavy attack by psyllids.

It appears that moderate temperatures together with high relative humidity favour a large increase in psyllid population in the areas studied (probably through conditions unfavourable to their natural parasites), causing the progressive debilitation of the trees and culminating in a greater susceptibility to attack by *X. truncatus*.

Observations on these factors are being continued.

#### Acknowledgements.

Acknowledgement is made to Mr. K. G. Campbell for assistance given, particularly with the timber assessments, and to Mr. P. Hadlington, officers of the Entomological Research Section, Forestry Commission of New South Wales. The writer is also grateful to Messrs. J. Catt and W. Mann of Lisarow, who readily gave permission to investigate and fell trees on their properties, and to many who assisted in the preparation of the manuscript.

#### References.

- BRIMBLECOMBE, A. R., 1953.—An Annotated List of the Scolytidae Occurring in Australia. *Q'd. J. Agric. Sci.*, 10 (3): 167-205.
- CAMPBELL, K. G., and MOORE, K. M., 1956.—An Investigation of the Food of the Bell-bird *Manorina melanophrys* Latham, *Proc. Roy. Zool. Soc. N.S.W.*, pp. 72-73. (May 1957.)
- COLLINS, C. W., et al., 1936.—*J. Econ. Ent.*, 29 (1): 169-176.
- ERICHSON, W. F., 1842.—*Arch. Naturgesch.*, 8 (1): 212.
- FROGGATT, W. W., 1926.—*Aust. For. J.*, 9: 144-5.
- LEA, A. M., 1893.—Descriptions of New Species of Bostrychidae. *Proc. Linn. Soc. N.S.W.*, 8 (2): 317-323.
- , 1904.—Australian Coleoptera. *Proc. Linn. Soc. N.S.W.*, 29 (1): 106.
- PARKER, K. G., et al., 1941.—*Phytopathology*, 31 (7): 657-663.

#### EXPLANATION OF PLATE VII.

1a. Colony-chambers of *X. truncatus* (Scolytidae) in *E. saligna* with associated staining of the timber. 1b. Adult beetle of *X. truncatus* (lateral view). 1c. Adult beetle of *X. truncatus* (dorsal view).

Photographs by D. Rose.